

# PATENT ABSTRACTS OF JAPAN

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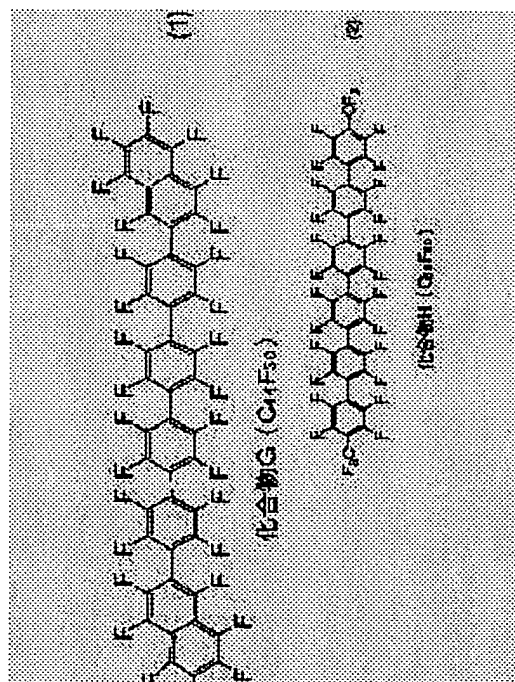
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## (54) ORGANIC COMPOUND AND ELEMENT USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an organic compound having high chemical and thermal stabilities and functions of carrier-transporting property, and the like.

SOLUTION: This organic compound has a skeleton in which three or more aromatic rings are bonded to each other at mutual arbitrary positions and is composed of only  $\geq 18$  carbon atoms and F. Specifically, the organic compound has a structure represented by the formula  $C_{6n}F_{4n+2}$  or the following formula (1) or (2) or is a compound composed of only C and F, in which a polyacene ring including naphthalene ring is directly



bonded. The compound exhibits transporting properties of electron and positive hole and can be used as an electron transporting layer, or the like, of an EL element and can be used as a positive hole-blocking layer when positive hole-blocking function is exhibited and can improve the element life when the compound is used as a protective film.

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE  
INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS  
DRAWINGS

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[Translation done.]

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a new organic compound, especially the luminescent material and the organic compound useful as a functional-device ingredient etc. in addition to this of organic electroluminescence devices (henceforth an organic EL device).

[0002]

[Description of the Prior Art] Generally as current and functional organic film, the compound of the structure which made the subject C<sub>6</sub>H<sub>6</sub> (benzene ring) and C-H coupling is used. Moreover, elements other than C and H element, such as oxygen (O), nitrogen (N), and sulfur (S), are used, and the organic film of various functionality is formed. These organic materials and an organic thin film are used for functional devices, such as optical devices, such as electric insulation film, a non-linear optical material, an electron hole transporting bed of an organic EL device, and an electronic transporting bed, and an electron device.

[0003]

[Problem(s) to be Solved by the Invention] Since C-H coupling of the functional organic material used conventionally [ above ] has a little small binding energy, by impressing an ultraviolet radiation exposure and high electric field, C-H coupling is cut and it has the fault that degradation of an ingredient progresses.

[0004] On the other hand, as an ingredient which made C-F association the subject, although polymeric materials, such as polytetrafluoroethylene (brand name "Teflon"), are excellent in thermal resistance or chemical stability, since it is an insulator with a large band gap, the application is limited. In functional devices, such as an organic EL device with which functions, such as carrier transportability and a luminescence, are demanded especially, it was not able to be used as a functional organic material demanded.

[0005] This invention is made in order to solve the above-mentioned technical problem, and it aims at offering the new organic compound equipped with various functions, maintaining thermal and chemical stability. Moreover, other objects are offering functional devices, such as an organic EL device which used the above-mentioned new organic compound.

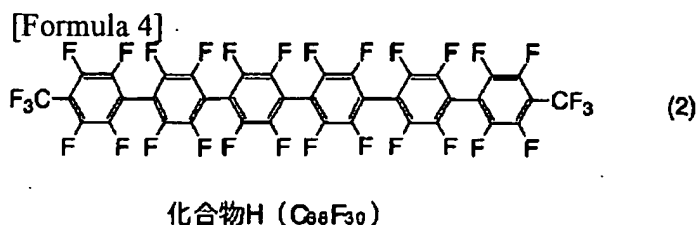
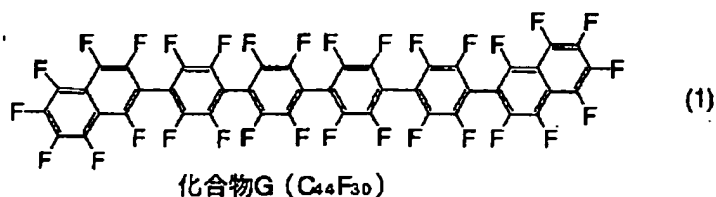
[0006]

[Means for Solving the Problem] The new organic compound concerning this invention has the frame which three or more aromatic series rings combined in the mutual arbitration location, and the number of the carbon atoms C consists of a carbon atom C and a fluorine atom F 18 or more.

[0007] Other descriptions of this invention are that the above-mentioned organic compound is a compound expressed with empirical formula C<sub>6n</sub>F<sub>4n+2</sub>.

[0008] For still more nearly another description of this invention, the above-mentioned organic compound is the following chemical formula (1) or a chemical formula (2).

[Formula 3]



It is the compound which is alike and is expressed with the shown structure.

[0009] The poly acene ring more than a naphthalene ring couples directly the organic compound concerning other descriptions of this invention in the location of arbitration, and all hydrogen is permuted by the fluorine.

[0010] Other descriptions are that the above-mentioned organic compound is a compound expressed with either empirical formula C<sub>10n</sub>F<sub>6n+2</sub>, C<sub>14n</sub>F<sub>8n+2</sub>, C<sub>18n</sub>F<sub>10n+2</sub> or C<sub>22n</sub>F<sub>12n+2</sub>.

[0011] Still more nearly another description of this invention is that this organic thin film contains the above-mentioned organic compound in the functional device which has an organic thin film.

[0012] Furthermore, another description is that said organic compound layer contains the above-mentioned organic compound in inter-electrode in the organic electroluminescence devices in which at least one-layer organic compound layer was formed.

[0013] Some aromatic series rings without C-H coupling, C<sub>6</sub>F<sub>6</sub> [ for example, ], (fluorobenzene) join together (at least three pieces), or some acene rings more than C<sub>10</sub>F<sub>8</sub> (fluoro naphthalene) join together, and the organic compound of above-mentioned this invention consists of only C and F. The increase of thermodynamic stability, glass transition temperature, and the melting point go up the compound which consists of only such C-C and C-F. Therefore, it becomes possible to raise the endurance and life of the device using the organic film which has C-F association.

[0014] Furthermore, since two or more aromatic series rings join together and are constituted, the organic compound of this invention is equipped with the structure in which pi conjugated system spread into the molecule, and it demonstrates the outstanding properties, such as carrier transportability. moreover, the organic compound of this invention -- an electronic object -- when it sees sexually, even if the electronegativity of F compares with H, since it is very large, from an aromatic series ring (for example, the benzene ring, a naphthalene ring, or the acene ring beyond it), in the F side, an electron should lengthen and blunder -- compared with a C-H compound, impregnation of the electron from cathode becomes easy.

[0015] It originates in the high electronegativity of F as mentioned above, an electron can draw near to the F side from an aromatic series ring (for example, benzene ring), LUMO (lowest unoccupied molecular orbital) of a molecule and HOMO (highest occupied molecular orbital) level fall, and such carrier (electron and electron hole) transportability is considered because impregnation into an electronic organic compound layer becomes easy. Furthermore, since conjugated system has spread in the molecule, the mobility of the electron poured in into the layer or an electron hole is large, and it is thought that it is because an electron and an electron hole can be carried efficiently.

[0016] Therefore, the organic compound of above-mentioned this invention can be used as a functional material of functional devices, such as an organic EL device, and component resistance is reduced by the activity of this organic compound, and it becomes possible to reduce the operating voltage of a component. For example, when the organic compound of this invention is used, the organic layer, for example, the electronic transporting bed, of an organic EL device, while an electron injection property improves compared with the electronic transporting bed which consists of a C-H system organic compound, since mobility is large, the driver voltage of an organic EL device falls.

[0017] Another description of this invention is having an electron hole shielding layer containing the

above-mentioned organic compound between said cathode and organic luminous layers among said organic compound layers in the organic electroluminescence devices by which the organic compound layer was formed between an anode plate and cathode.

[0018] The organic compound of this invention is a compound stable as mentioned above, and its HOMO level is low. Therefore, since HOMO level is low compared with a general electron hole transporting bed and a general luminous layer, the layer which contains the organic compound of this invention, for example in an organic EL device can block an electron hole. For this reason, if it uses as such an electron hole blocking layer, it becomes possible to confine an electron hole in an organic luminous layer, and improvement in the luminous efficiency of a component can be realized.

[0019] In addition, if an electrode material is chosen so that the obstruction height of the C-F compound of this invention to the electrode of a component may become small, since the mobility of the electron hole which the hole injection to the C-F compound layer of this invention of became possible, and was poured in is fully large as mentioned above, it is also possible to use as electron hole transporting beds, such as an organic EL device.

[0020] Other descriptions of this invention are organic electroluminescence devices which equip inter-electrode with an organic compound layer, and are having used the above-mentioned organic compound for this component as a wrap protective coat.

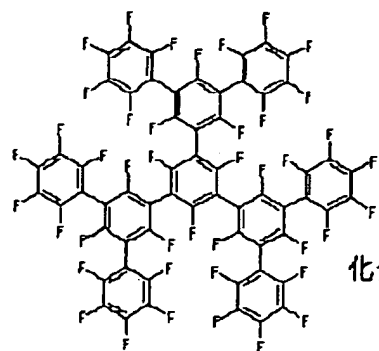
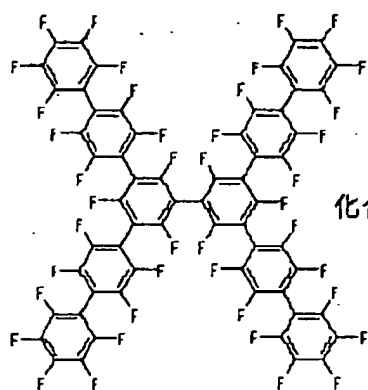
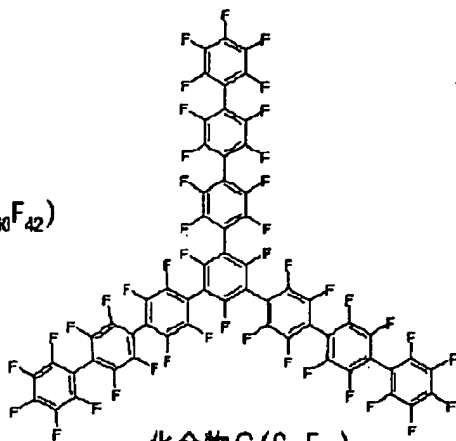
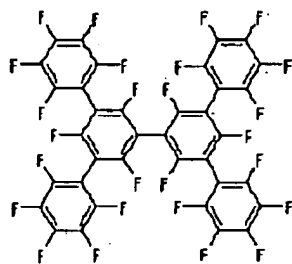
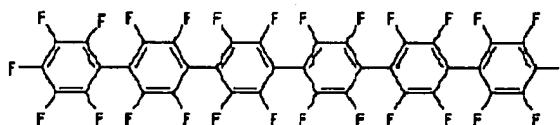
[0021] Compared with the device protective coat using a C-H system compound, the C-F compound of this invention has the low interaction of molecules, and since surface energy falls, a good water-repellent property is shown. For this reason, the high effectiveness as a protective coat of preventing trespass of the moisture to a device etc. shows up. For example, although it is known that moisture will have very serious effect on the component life in the present organic EL device, by using the C-F compound of above this inventions as protective coats, such as such a waterproof low component, the moisture content with which the high water repellence of the compound invades into a component can be reduced, and the endurance and the life of a device can be improved.

[0022]

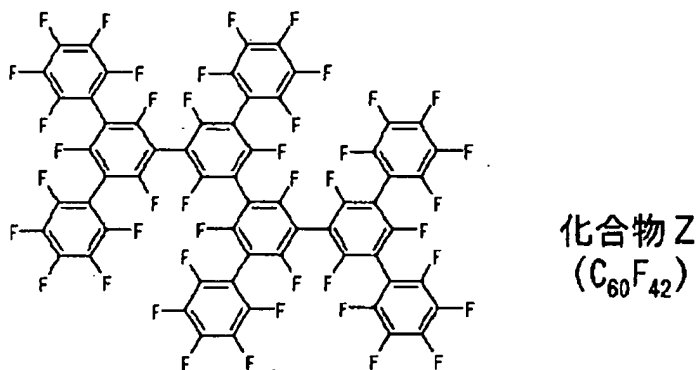
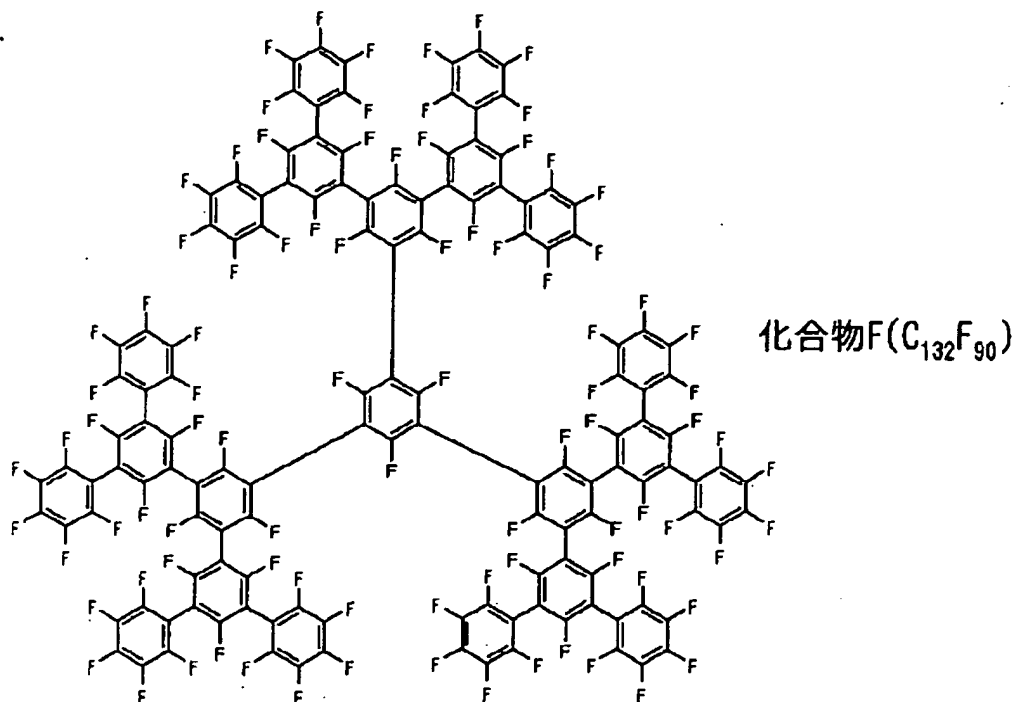
[Embodiment of the Invention] Hereafter, the gestalt (henceforth an operation gestalt) of suitable implementation of this invention is explained using a drawing.

[0023] The organic compound of the [operation gestalt 1] book operation gestalt has the frame which three or more aromatic series rings combined in the mutual arbitration location, and the number of the carbon atoms C consists of a carbon atom C and a fluorine atom F 18 or more.

[0024] As an example of this compound, it is the following chemical formula [\*\* 5].

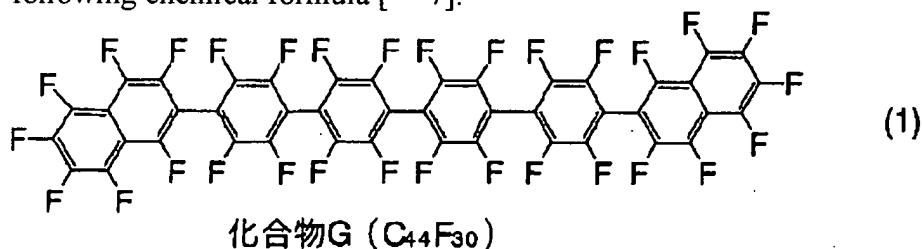
化合物A (C<sub>60</sub>F<sub>42</sub>)化合物B (C<sub>60</sub>F<sub>42</sub>)化合物C (C<sub>60</sub>F<sub>42</sub>)化合物D (C<sub>38</sub>F<sub>24</sub>)化合物E (C<sub>36</sub>F<sub>28</sub>)

[Formula 6]



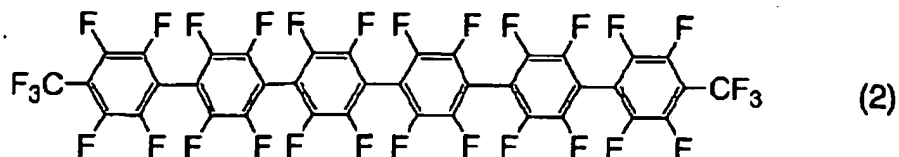
The organic compounds A, B, C, D, E, F, and Z to boil and by which an empirical formula as shown is expressed with  $C_6nF_{4n+2}$  are mentioned. Any [ these ] organic compound has three or more fault fluoride aromatic series rings, and is equipped with the structure from which conjugated system developed.

[0025] Moreover, as other examples of the organic compound of this operation gestalt, it is the following chemical formula [\*\* 7].



[Formula 8]



化合物H (C<sub>38</sub>F<sub>30</sub>)

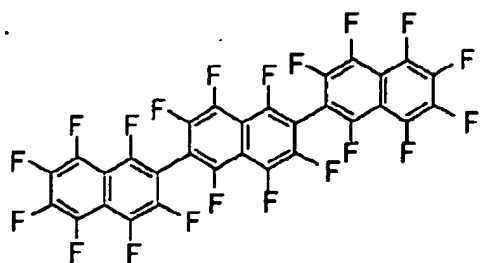
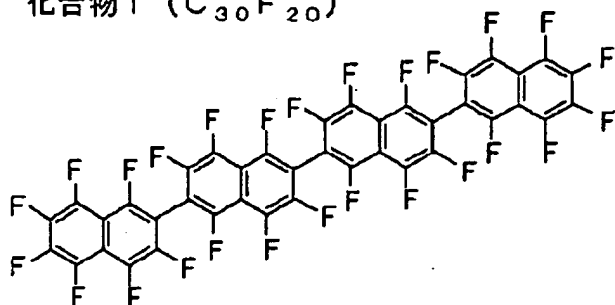
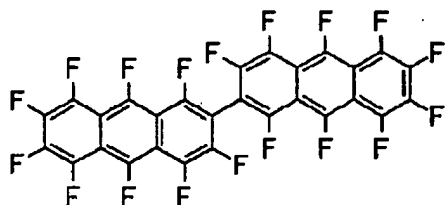
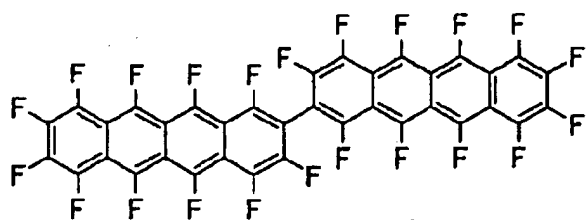
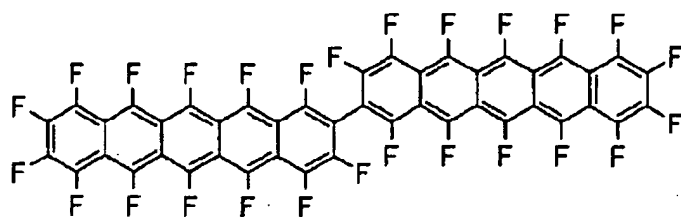
It is alike and the compounds G and H of the shown structure are mentioned.

[0026] Compound B, Compound C, compound E, Compound G, Compound H, etc. are especially equipped with the molecular structure from which other fault fluoride aromatic series rings combined with those para positions, and conjugated system developed widely among the above-mentioned compounds.

[0027] Other examples of the organic compound of this operation gestalt are organic compounds by which the poly acene ring more than a naphthalene ring couples directly with in the location of arbitration, and all hydrogen is permuted with the fluorine. As an example of this compound, the compound expressed with either empirical formula C<sub>10n</sub>F<sub>6n+2</sub>, C<sub>14n</sub>F<sub>8n+2</sub>, C<sub>18n</sub>F<sub>10n+2</sub> or C<sub>22n</sub>F<sub>12n+2</sub> is mentioned. More specifically, the compounds I, J, K, L, and M of structure as shown below are mentioned.

[0028]

[Formula 9]

化合物 I ( $C_{30}F_{20}$ )化合物 J ( $C_{40}F_{26}$ )化合物 K ( $C_{28}F_{18}$ )化合物 L ( $C_{36}F_{22}$ )化合物 M ( $C_{44}F_{28}$ )

Its thermodynamic stability is high while the organic compound of these book operation gestalt is equipped with water repellence, and the glass transition temperature and melting point are high. Moreover, since two or more aromatic series rings join together and are constituted, it has into the molecule the structure in which pi conjugated system spread, and the property which was excellent in carrier transportability etc. is demonstrated. especially, in these organic compounds, since it is very large compared with H, an electron should lengthen from the aromatic series ring (for example, the benzene ring, a naphthalene ring, or the acene ring beyond it) to the F side, and the electronegativity of F should blunder -- LUMO of a molecule and HOMO level are low and it excels in a carrier, especially electronic

transition nature compared with a C-H compound.

[0029] With the [operation gestalt 2] book operation gestalt 2, the organic compound (fluoride compound) with which it has the frame which three or more aromatic series rings illustrated in the above-mentioned operation gestalt 1 combined in the arbitration location, and a carbon atomic number consists of 18 or more, a carbon atom C, and a fluorine atom F is used as an ingredient of the organic thin film of an optical device or an electron device.

[0030] As an example of these devices, the organic EL device with which at least one-layer organic compound layer is formed in below inter-electrode is mentioned as an example, and is explained.

[0031] The outline structure of the organic EL device applied to the operation gestalt 2 at drawing 1 is shown. On the transparency substrate 10, the laminating of the 1st electrode 12, and the organic compound layer 20 and the 2nd electrode 16 which emit light by impression of electric field is carried out to order, and the organic EL device is constituted.

[0032] As a transparency substrate 10, a glass substrate, a transparent-ceramics substrate, a diamond substrate, etc. can be used. The transparent electrode which has high light transmission nature and conductivity as the 1st electrode 12 is used, for example, thin film materials, such as ITO (Indium Tin Oxide), SnO<sub>2</sub>, In<sub>2</sub>O<sub>3</sub>, and the poly aniline, can be used.

[0033] In an organic EL device, the organic compound layer 20 is a part which emits light by impression of electric field, for example, consists of monolayer structure of a luminous layer, two-layer structure of an electron hole transporting bed and a luminous layer, a three-tiered structure of an electron hole transporting bed, a luminous layer, and an electronic transporting bed, etc. a monolayer and a multilayer -- it may consist of which and the thickness of the organic compound layer 20 is dozens to hundreds of nm. With this operation gestalt 2, the configuration in which three layers, the electron hole transporting bed 22, a luminous layer 24, and the electronic transporting bed 26, were formed between anode plate-cathode is used for the organic compound layer 20, and the fluoride compound (C-F compound) explained with the above-mentioned operation gestalt 1 as an ingredient of the electronic transporting bed 26 of these is used for it.

[0034] As the 2nd electrode 16 currently formed on the organic compound layer 14, metal electrodes, such as Mg, Ag, a Mg-Ag alloy, an aluminum-Li alloy, and LiF/aluminum, are used, for example.

[0035] In the organic compound layer 20 of a three-tiered structure, for example, a triphenylamine tetramer (TPTE) is usable as an electron hole transporting bed 22. Moreover, as a luminous layer 24, for example, a quinolinol aluminum complex (Alq<sub>3</sub>) is usable. In addition, not only the above-mentioned example but the electron hole transport functional molecule and luminescence functional molecule which are known now can be used for these electron hole transporting bed 22 and a luminous layer 24.

[0036] As an electron hole transporting bed ingredient, the following ingredients can be used, for example. Aromatic series tertiary amine, a hydrazone, carbazoles, or those derivatives. Aromatic series tertiary amine is N, N'-screw (3-methylphenyl)-N, and N'-diphenyl. - (1 and 1'-biphenyl) -4, 4'-diamine (TPD), Triphenylamines and the polymers of those, such as N, N'-JI (1-naphthyl)-N, N'-diphenyl-[1 and 1'-biphenyl]-4, and 4'-diamine (alpha-NPD), Or you may be what has a SUPIRO pin center, large in intramolecular, and the so-called pi electron system starburst molecules, such as a thoria reel amine.

[0037] As a luminous layer ingredient, the following ingredients can be used, for example. Independent or combination of quinone derivatives, such as the ingredient which gives high fluorescence quantum yield in a thin film condition, for example, an OKISA thiazole, a phenanthrene, triazole, Quinacridone, rubrene, coumarins, those derivatives, or 8-hydroxyquinoline, and a metal complex with aluminum, zinc, peri RIUMU, etc.

[0038] Moreover, as an electronic transporting bed 26, the C-F compound of the operation gestalt 1 is used as mentioned above.

[0039] The 1st electrode 12 is made into an anode plate in the organic EL device of the above configurations. An electron hole transporting bed conveys the electron hole poured in from an anode plate to a luminous layer, using the 2nd electrode 16 as cathode. An electron hole and an electron are injected into the organic compound layer 20 because the electronic transporting bed which consists of an above-mentioned fluoride compound conveys the electron poured in from cathode efficient, an electron hole and an electron recombine within the layer of a luminous layer 24, luminescent material is excited, and fluorescence is acquired.

[0040] A C-F compound is  $-2.17\text{--}2.49\text{V}$  to the reduction potential showing the LUMO level of Alq3 being  $-2.38\text{V}$  if the C-F compound shown in the above-mentioned operation gestalt 1 used here as Alq3 conventionally known also as an electronic transport functional molecule and an electronic transporting bed 26 is compared. The LUMO level of the organic film which constitutes the electronic transporting bed 26 means that an electron is easy to be poured in from the cathode using aluminum, so that it is low. Therefore, an electron can be easily poured into the electronic transporting bed 26 which consists of a C-F compound of this invention from aluminum electrode, and it becomes easy to make low the standup electrical potential difference (luminescence threshold voltage) of an organic EL device by using a C-F compound as an electronic transporting bed 26.

[0041] In order to show electron mobility with expensive the compound of structure with which the fluorobenzene ring joined together with the mutual para position among the fluoride compounds of the above-mentioned operation gestalt 1, and conjugated system was prolonged especially for a long time, for example, compound E, Compound H, Compound G, etc., these are excellent as an ingredient of the electronic transporting bed of an organic EL device.

[0042] Moreover, the poly acene more than the naphthalene ring expressed with empirical formula  $\text{C}_{10n}\text{F}_{6n+2}$ ,  $\text{C}_{14n}\text{F}_{8n+2}$ ,  $\text{C}_{18n}\text{F}_{10n+2}$ , and  $\text{C}_{22n}\text{F}_{12n+2}$  is excellent also in the fluoride compound coupled directly in the arbitration location in the compound of the operation gestalt 1. For example, pi conjugated system is dramatically long, and shows high electron mobility, and the above-mentioned compounds I, J, K, L, and M etc. are excellent in it as an electronic transport ingredient of an organic EL device, though thermal and chemical stability are maintained.

[0043] Moreover, the C-F compound concerning this invention is excellent in stability with it. [ C-F binding energy larger than C-H coupling and ] [ thermal ] For this reason, to chip temperature lifting under component actuation known as an important factor of degradation of an organic EL device, the electronic transporting bed using the C-F compound concerning this invention shows the outstanding thermal resistance, i.e., the outstanding film stability, and contributes to extension of the brightness reduction-by-half life of a component greatly.

[0044] With the [operation gestalt 3] above-mentioned implementation gestalt 2, although the C-F compound of this invention is used as an electronic transporting bed ingredient of an organic EL device, in the operation gestalt 3, it prepares between an electrode (cathode) and an organic luminous layer, and uses as an electron hole shielding layer. Drawing 2 shows the outline configuration of the organic EL device concerning this operation gestalt 3. The 1st electrode 12, the organic compound layer 20, and the 2nd electrode 16 are formed on a substrate 10, and the organic compound layer 20 consists of an electron hole transporting bed 22, a luminous layer 24, and an electronic transporting bed 28. Furthermore, the electron hole shielding layer 30 using the C-F compound more specifically explained in the operation gestalt 1 between the electronic transport (Alq3) layer 28 and the luminescence (Alq3) layer 24 is formed between the 2nd electrode 16 used as cathode, and a luminous layer 24.

[0045] An organic EL device pours an electron and an electron hole into a luminous layer from cathode and an anode plate as mentioned above, is made to recombine them by the luminous layer, and obtains luminescence. In order to raise luminous efficiency in such an organic EL device, an electron and an electron hole need to recombine efficiently within a luminous layer. Current and the aluminum quinolinol complex (Alq3) currently used abundantly as a luminescent material are known as a luminescent material which makes an electronic transport function serve a double purpose. And an electron hole is also conveyed although the inside of this Alq3 mainly conveys an electron. Therefore, when three layer of Alq(s) are formed as a luminous layer of electronic transporting bed combination, even if an electron hole is poured into a luminous layer (three layer of Alq(s)) through an electron hole transporting bed from an anode plate, the electron hole conveyed to cathode, without recombining all with an electron within a luminous layer exists, and it leads to decline in luminous efficiency.

[0046] Drawing 3 shows the electron hole shielding effect at the time of forming an above-mentioned C-F compound ( $\text{CxFy}$ ) as an electron hole shielding layer 30 between cathode and a luminous layer like this operation gestalt 3. The electron hole poured in from an anode plate conducts the HOMO level of an organic compound layer, and reaches to three layer of Alq(s) which are a luminous layer. Between an anode plate, an electron hole transporting bed (TPTE layer) and an electron hole transporting bed, and a luminous layer, since the gap of the HOMO level between layers is small, an electron hole is poured in

from an anode plate toward a luminous layer. However, like drawing 3, since that HOMO level is low, especially as for the C-F compound of this invention explained with the operation gestalt 1, an electron hole cannot pass along the obstruction between a luminous layer and this C-F compound layer. For this reason, a C-F compound layer functions as a block layer of an electron hole. On the other hand, conjugated system is developed, since LUMO level is also low, this C-F compound tends to let an electron pass, and it demonstrates an electronic transport function while it functions as an electron hole shielding layer. Therefore, it becomes possible to shut up an electron and an electron hole efficiently and to make them emit light to a luminous layer by existence of the C-F compound layer which is an electron hole shielding layer of the electronic transport functional combination formed between cathode and a luminous layer.

[0047] As this electron hole shielding layer, sufficient electron hole electric shielding nature, i.e., HOMO level is fully low, is required first. Both above-mentioned compound A -M and the compound Z fulfill such conditions. Moreover, since it is arranged between cathode and a luminous layer, in order to make a component emit light, it is required that an electronic transport function should also be high. Like the above-mentioned operation gestalt 2, electronic transportability has the structure advantageous to the mutual para position where the aromatic series ring is connected for a long time, compound E is superior to Compound B also as an electron hole shielding layer, and it becomes easy from Compound C and Compound C to realize a better property with Compounds G and H.

[0048] With the [operation gestalt 4] book operation gestalt 4, a C-F compound which was explained in the above-mentioned operation gestalt 1 is used as a protective coat of a component. Especially in the organic EL device from which the water resisting property with a low component poses a problem, it makes it possible to prolong a component life by leaps and bounds by using the C-F compound of this invention for a component as an ingredient of a wrap protective coat.

[0049] Drawing 4 (a) shows the example of a configuration at the time of using an above-mentioned C-F compound as a protective coat of an organic EL device. In addition, drawing 4 (b) shows the configuration for general organic EL device protection.

[0050] The organic compound layer 20 is formed between the 1st electrode 12 and the 2nd electrode 16, and with this operation gestalt 4, after forming the 2nd electrode 16 on the organic compound layer 20 so that the organic compound layer 20 may not be put to the open air at least, the protective coat 40 of the component formed on the substrate 10 which consists of a C-F compound so that the whole surface may be covered mostly is formed. Since the C-F organic compound concerning this invention can be formed on a component by vacuum evaporation, it becomes easy [ component manufacture ] dramatically [ it ]. in order to intercept an organic EL device from the open air generally on the other hand -- drawing 4 -- as shown in </A (b)>, it is a desiccation nitrogen (N2) ambient atmosphere after component formation, and to the substrate 10 (actually the 1st electrode 12), a wrap case is pasted up and the component is closed.

[0051] Since the C-F organic compound of this invention can form the precise film in which the outstanding water repellence is shown, it only forms a protective coat using this C-F compound so that an organic EL device may be covered, and can acquire effectiveness equivalent to having closed the organic EL device like drawing 4 (b). Moreover, since this C-F compound that is an organic compound can be formed by the vacuum evaporation approach, even if it does not attach a special closure case etc., it becomes possible [ protecting a component ]. For this reason, it becomes possible to manufacture a component in a simple process very effectively also in respect of thin-shape-izing of an organic EL device, and a miniaturization.

[0052] In addition, it becomes it is possible to use a C-F compound also as a protective coat using the C-F compound of this invention, and possible [ also producing an organic compound layer and a protective coat by the common manufacturing installation ] like the above-mentioned operation gestalten 2 and 3 also as an ingredient of the organic compound layer 20 of an organic EL device. Although all of the C-F compound explained in the operation gestalt 1 as an ingredient of a protective coat can be used, compound A with torsion or the structure of branching, Compound D, etc. are more superior to compound E, and H and G.

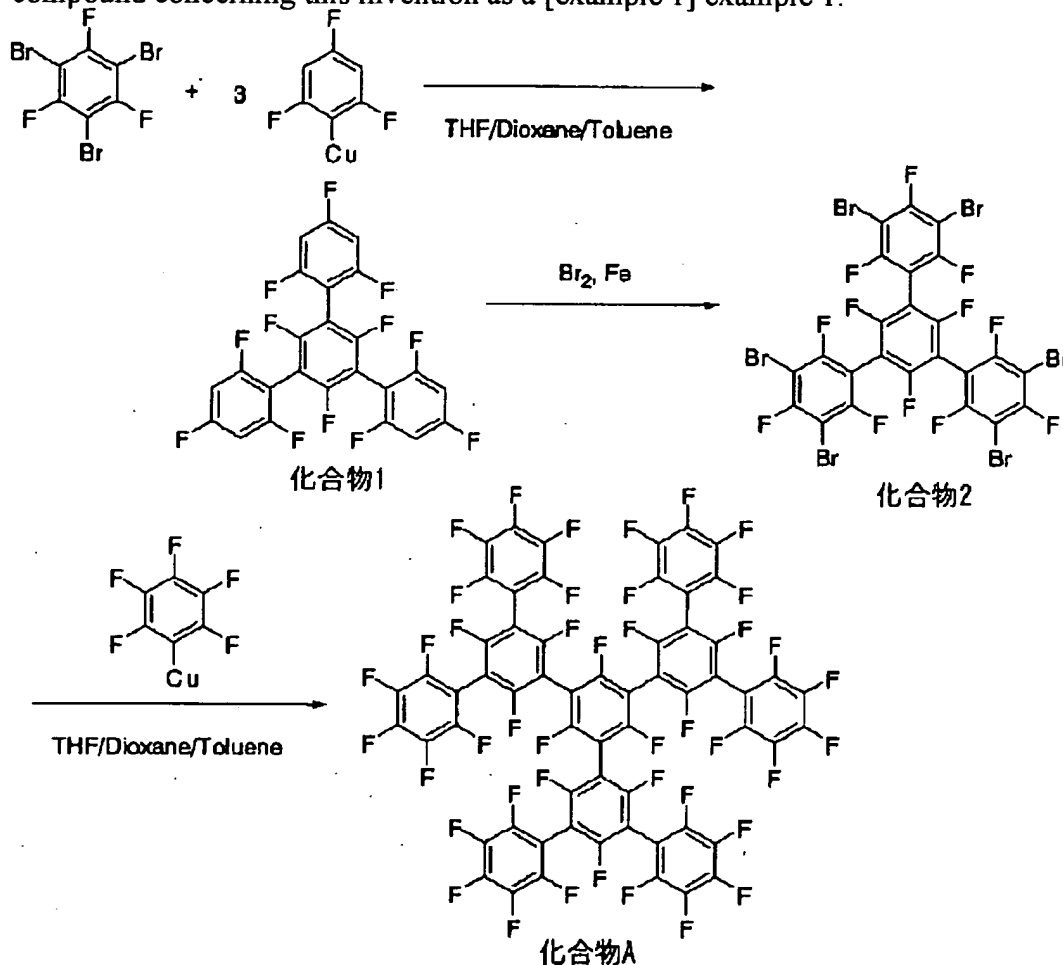
[0053] In addition, the C-F compound which has the C-F compound shown in the operation gestalt 1, one piece, or two aromatic series rings, and consists only of carbon and a fluorine in the operation

gestalt 2-4 above can also be used.

[0054]

[Example] The example of this invention is explained below, respectively.

[0055] It is the following reaction formula [\*\* 10] to an example about the compound A (C<sub>60</sub>F<sub>42</sub>) of the structure which a total of ten fluorobenzenes combined about the synthetic example of the C-F compound concerning this invention as a [example 1] example 1.



It refers to and explains below.

[0056] (i) Under the synthetic argon air current of a compound 1 (1, 3, 5-trifluoro- 2, 4, 6-tris(2, 4, 6-trifluorophenyl) benzene), Magnesium (2.91g, 120mmol), and 1-BUROMO - 2, 4, and 6-trifluoro benzene [-- 1-bromo- an anhydrous copper bromide into the Grignard reagent adjusted in THF (120ml) from 2, 4, and 6-trifluorobenzene] (25.3g, 120mmol) After adding (34.4g, 240mmol) and stirring at a room temperature for 1 hour, dioxane (30ml) was added and it stirred for further 1 hour. this suspension -- 1 and 35-TORIBUROMO - 2, 4, and 6-trifluoro benzene [-- 1, 3, and 5-tribromo- the toluene (200ml) solution of 2, 4, and 6-trifluorobenzene] (9.22g, 25.0mmol) was added, and it stirred for four days at 80 degrees C. After filtering the reaction mixture and carrying out reduced pressure distilling off of the solvent, residue was dissolved in toluene. With 3M hydrochloric acid, saturation brine washed further, and washing and after drying with sulfuric anhydride magnesium, reduced pressure distilling off of the toluene was carried out for this toluene solution. compound 1: which \*\*\*\*\*s the obtained reaction mixture from ethanol/water, and is made into the object -- 1, 3, and 5-trifluoro - 2, 4, and 6-tris (2, 4, 6-trifluoro phenyl) benzene [-- 1, 3, and 5-trifluoro- 2, 4, and 6-tris(2, 4, 6-trifluorophenyl) benzene] (7.61g, 58%) was obtained. Furthermore, the filtrate was condensed under reduced pressure and the compound 1 (g [ 1.40 ], 11%) was obtained by carrying out separation purification of the residue with a silica gel column chromatography (hexane).

[0057] When the melting point of this compound 1 was measured, it was Mp.=157 degree-C-158 degree C, and when the <sup>19</sup>F-nucleus porcelain resonance spectrum (<sup>19</sup>F-NMR (470.4MHz, CDCl<sub>3</sub>)) was

measured in heavy chloroform, chemical shift delta was observed in the location of 56.50-56.58 (m, 3F), 56.28-56.37 (m, 3F), and 54.96-55.06 (m, 6F). Moreover, with the <sup>1</sup>H-nucleus porcelain resonance spectrum (<sup>1</sup>H-NMR (500MHz, CDCl<sub>3</sub>)), delta was observed in heavy chloroform in the location of 6.80-6.86 (m, 6H). The peak of 522 (M<sup>+</sup>, 100%) and 261 (M<sup>+</sup>-2C<sub>6</sub>H<sub>2</sub>F<sub>3</sub>, 33.5%) was observed as a result of mass analysis (EIMS (m/z, relative intensity)). From these analysis, the compound 1 has been checked as it is C<sub>24</sub>H<sub>6</sub>F<sub>12</sub>.

[0058] (ii) The bromine was dropped at the synthetic above-mentioned compound 1 (g [ 5.60 ], 12.4mmol) of a compound 2 (1, 3, 5-trifluoro- 2, 4, 6-tris(3, 5-dibromo- 2, 4, 6-trifluorophenyl) benzene), and the mixture of reduced iron at the room temperature, and it stirred for three days at 60 degrees C. The sodium-thiosulfate water solution was added to this reaction mixture, and it extracted by dichloromethane. Saturation brine washed the organic layer, and after drying with sulfuric anhydride magnesium, it condensed under reduced pressure. compound 2: which \*\*\*\*\*s the obtained reaction mixture from a hexane and is made into the object -- 1, 3, and 5-trifluoro- 2, 4, and 6-tris (3, 5-dibromo - 2, 4, 6-trifluoro phenyl) benzene [-- 1, 3, and 5-trifluoro- 2, 4, and 6-tris(3, 5-dibromo- 2, 4, 6-trifluorophenyl) benzene] (9.71g, 79%) was obtained.

[0059] When the melting point of this compound 2 was measured, it was Mp:269 degree-C-270 degree C, and when the <sup>19</sup>F-nucleus porcelain resonance spectrum (<sup>19</sup>F-NMR (470.4MHz, CDCl<sub>3</sub>)) was measured in heavy chloroform, chemical shift delta was observed in the location of 70.35 (s, 3F), 60.61 (s, 6F), and 59.04 (s, 3F). In the result of mass analysis (EIMS (m/z, relative intensity)), the peak of 989 (M<sup>+</sup>, 3.4%), 991 (M<sup>++</sup>2, 30.1%), 993 (M<sup>++</sup>4, 56.9%), 995 (M<sup>++</sup>6, 100%), 997 (M<sup>++</sup>8, 54.8%), and 999 (M<sup>++</sup>10, 38.2%) was observed. From these analysis, the compound 2 has been checked as it is C<sub>24</sub>Br<sub>6</sub>F<sub>12</sub>.

[0060] Under the synthetic argon air current of compound A (1, 3, 5-trifluoro- 2, 4, 6-tris(3, 5-bis (pentafluorophenyl)- 2, 4, 6-trifluorophenyl) benzene), (iii) Into the Grignard reagent adjusted in THF (30ml) from magnesium (0.292g, 12.0mmol) and BUROMO pentafluoro benzene [bromopentafluorobenzene] (2.97g, 12.0mmol) After adding the anhydrous copper bromide (3.44g, 24.0mmol) and stirring at a room temperature for 1 hour, dioxane (15ml) was added and it stirred for further 1 hour. The toluene (30ml) solution of a compound 2 (g [ 0.996 ], 1.00mmol) was added to this suspension, and it stirred at 80 degrees C for 24 hours. The reaction mixture was filtered, reduced pressure distilling off of the solvent was carried out, and residue was dissolved in toluene. With 3M hydrochloric acid, saturation brine washed further, and washing and after drying with sulfuric anhydride magnesium, reduced pressure distilling off of the toluene was carried out for this toluene solution. Compound A made into the object by carrying out separation purification of the obtained reaction mixture by the silica-gel-column chromatography (a hexane/toluene = 20/1): 1, 3, 5-trifluoro - 2, 4, and 6-tris (3, 5-screw (pentafluorophenyl) - 2, 4, 6-trifluoro phenyl) benzene (1.29g, 85%) was obtained.

[0061] When the melting point of this compound A was measured, it was dramatically as high as Mp:273 degree-C-274 degree C. Moreover, the place which measured the <sup>19</sup>F-nucleus porcelain resonance spectrum (<sup>19</sup>F-NMR (470.4MHz, CDCl<sub>3</sub>)) in heavy chloroform, chemical shift delta -- 61.04 (s, 3F), 60.67 (s, 6F), 60.43 (s, 3F), and 24.26- it was observed in the location of 24.49 (m, 12F), 13.31 (t, J= 21.6Hz, 6F), and 2.42-2.60 (m, 12F). The peak of 1518 (M<sup>+</sup>, 100%) was observed in the result of mass analysis (EIMS (m/z, relative intensity)). From these analysis, compound A has been checked as it is C<sub>60</sub>F<sub>42</sub>.

[0062] The example which produced the organic EL device, using the C-F organic compound of this invention as an electronic transporting bed ingredient as shown in the [example 2] operation gestalt 2 is explained as an example 2-1 and 2-2 below.

[0063] (Production of a component) A component configuration is as being shown in above-mentioned drawing 1. As a substrate 10, ITO used as the 1st electrode 12 used the glass substrate by which pattern NINGU is carried out. this substrate 10 -- organic alkali cleaner SEMIKO -- clean -- in order of 56 (fruity chemistry), pure water, an acetone, and ethanol, after ultrasonic cleaning, in order to remove the organic pollutant on the front face of ITO, UV ozonization was performed and it set in vacuum evaporationo equipment quickly. next, the mask for [ in a vacuum ] organic compound layers -- equipping -- after that -- with carbon crucible heating, as an organic compound layer 20, first, the electron hole transporting bed 22 [a triphenylamine tetramer] was formed by 60nm, and 40nm and the

electronic transporting bed 26 [a C-F compound] were formed for the luminous layer 24 [a quinolinol aluminum complex (Alq3)] in 20nm order. The membrane formation rate was made into 2 - 6 nm/min. [0064] Next, the mask was changed into cathode electrodes (the 2nd electrode) in the vacuum, LiF was formed with 3 nm/min from Ta boat, 160nm of aluminum was formed with 0.5nm by the rate of sedimentation of 10 nm/min from the PBN crucible, respectively, and the 2nd electrode 16 of a laminated structure was obtained. Each film which constitutes a component formed membranes on the conditions of 5x10 to 7 or less Torr about the degree of vacuum.

[0065] As an electronic transporting bed 26, seven kinds of organic EL devices using above-mentioned compound A, and B, C, D, E, F and Z were produced about the example 2-1, respectively. Moreover, about the example 2-2, two kinds of organic EL devices were created as an electronic transporting bed 26, using the above-mentioned compounds I and J respectively.

[0066] The component of the structure which formed Alq3 [ 20nm ] instead of the electronic transporting bed 26 in drawing 1 as an example 1 of a comparison was produced.

[0067] (Characterization) About the organic EL device produced by the above-mentioned approach, the relation between applied voltage, luminescence brightness and an inrush current consistency, and luminescence brightness was measured in the chamber which fully carried out the nitrogen purge, and it computed also about luminous efficiency. Moreover, the current was poured in so that initial brightness might become 2400 cd/m<sup>2</sup>, and the driver voltage dependency of brightness was also measured.

[0068] The assessment result about an example 2-1 is shown in drawing 5 - drawing 7 . As for all of these organic EL devices, green luminescence from a luminous layer Alq3 was obtained. In the example 1 of a comparison, Alq3 serves both as the luminous layer and the electronic transporting bed, it starts, and an electrical potential difference is 4V. In this example 2-1, although the component equipped with the electronic transporting bed 26 which consists of a C-F compound starts about one example of a comparison and there is much what has a not low electrical potential difference, the electron is still poured fully into the C-F electronic transporting bed from aluminum electrode. Moreover, as shown in drawing 6 , as for each component of this example 2-1, it turns out that two or more 1000 cd/m luminescence brightness is obtained, and the electron is conveyed to a luminous layer 24 (Alq3).

Especially the component using the compound E to which the fluorobenzene combined with the para position and the \*\*\*\* system extended for a long time is most excellent in the property, and most EL properties shown in drawing 5 - drawing 7 are equivalent to the example of a comparison of Alq3.

[0069] Moreover, as for each component in which the C-F electronic transporting bed 26 of an example 2 was formed, the reduction-by-half life of the brightness when making initial brightness into 2400 cd/m<sup>2</sup> also showed the reduction-by-half life of about 20 hours to 15 hours of the example 1 of a comparison.

[0070] The assessment result about an example 2-2 is shown in drawing 8 and drawing 9 . First, green luminescence from a luminous layer Alq3 was obtained for any organic EL device which used Compound I or Compound J for the electronic transporting bed. And less than [ 4V ] is attained, the organic EL device concerning the example 2-2 which the example 1 of a comparison for which Alq3 served both as the luminous layer and the electronic transporting bed started, and used Compounds I and J for the electronic transporting bed to being electrical-potential-difference 4V as shown in drawing 8 has a low standup electrical potential difference, and it turns out that enough electrons are poured into the electronic transporting bed of a fault fluoride compound (C-F) from aluminum electrode. Moreover, even if it compares with each component of an example 2-1, it turns out [ very low ] that it starts and the electrical potential difference is realized. About luminescence brightness, as shown in drawing 9 , with the organic EL device of an example 2-2, two or more 10000 cd/m is attained and it turns out completely equivalent to the example 1 of a comparison, or that the property beyond it is acquired and the electron is conveyed to a luminous layer Alq3.

[0071] The example which produced the organic EL device, using the C-F organic compound of this invention as an electron hole shielding layer ingredient as shown in the [example 3] operation gestalt 3 is explained as an example 3 below.

[0072] (Production of a component) The configuration of the organic EL device of this example 3 is as being shown in drawing 2 . As a substrate 10, the same glass substrate 10 with washed ITO(12) as the above-mentioned example 2 was used. 35nm of Alq(s)3 was formed for a C-F organic compound



(compounds B and C) which shows 60nm and a luminous layer 24 [an aluminum quinolinol complex (Alq3)] to the above-mentioned operation gestalt 1 as an electron hole shielding layer 30 for the electron hole transporting bed 22 [a triphenylamine tetramer] at 20nm and a degree as 5nm and an electronic transporting bed 28 as organic film by heating a carbon crucible after equipping with the mask for organic film in a vacuum. These membrane formation rate was made into 2 - 6 nm/min.

[0073] Next, the mask was changed to cathode electrodes in the vacuum, the LiF electron injection layer was formed by 2 nm/min from Ta boat, 0.5nm and 160nm of aluminum were formed by the rate of sedimentation of 10 nm/min from the PBN crucible, and the 2nd electrode 16 of a laminated structure was obtained. In addition, each film which constitutes a component formed membranes on the conditions of  $5 \times 10^{-7}$  to  $7 \times 10^{-7}$  or less Torr about the degree of vacuum.

[0074] Moreover, the organic EL device (organic-compound layer: TPTE/Alq3) without an electron hole shielding layer was produced as an example 2 of a comparison.

[0075] (Characterization) About the organic EL device produced by the above-mentioned approach, the relation of an inrush current consistency, luminescence brightness, and applied voltage and luminescence brightness was measured in the chamber which fully carried out the nitrogen purge, and it computed also about luminous efficiency. Moreover, the current was poured in so that initial brightness might become 2400 cd/m<sup>2</sup>, and the driver voltage dependency of brightness was also measured.

[0076] An assessment result is shown in drawing 10 and drawing 11. The component using Compounds B and C as an electron hole shielding layer 30 is falling like an example 3 to an electrical potential difference with the driver voltage comparable as the example 2 of a comparison of Alq3, respectively. This shows that the C-F compound used as an electron hole shielding layer is fully working also as an electronic transporting bed. Furthermore, even if it pays its attention to a three layer [ of Alq(s) as aluminum cathode and a luminous layer ] interface about any of Compounds B and C with the component of this example 3 compared with the component in which the C-F compound layer as an electronic transporting bed was formed, like the above-mentioned example 2, luminescence brightness is improving in each stage. Therefore, it turns out that luminous efficiency improves by producing the organic EL device which used the C-F compound of this invention for the electron hole shielding layer, and the luminous efficiency (cd/A) more than the component which does not have an electron hole shielding layer like the example 2 of a comparison, and an EQC can be attained easily.

[0077] Moreover, to 15 hours of the example 2 of a comparison, the reduction-by-half life of the brightness when making initial brightness into 2400 cd/m<sup>2</sup> was also prolonged with each component concerning an example 2 in 20 hours or more, and the reinforcement of it became possible with it.

[0078] The example which used the C-F organic compound of this invention as a protective coat of an organic EL device as shown in the [example 4] operation gestalt 4 is explained as an example 4 below.

[0079] (Production of a component) The component which that of production of a component is the same as that of the examples 1 and 2 of a comparison of the above-mentioned examples 2 and 3 to the process which produces aluminum cathode, and is equipped with the organic compound layer 20 of TPTE and the two-layer structure of Alq3 was produced (refer to drawing 4 (a)). Then, at this example 4, 300nm (compound A, B, D) of C-F compounds of this invention explained in the operation gestalt 1 as a protective coat 40 as shown in drawing 4 (a) was formed by rate-of-sedimentation 5 nm/min. Moreover, the component closed with desiccation nitrogen was produced with the component and closure case which do not form the protective coat like drawing 4 (b) as examples 3 and 4 of a comparison.

[0080] (Characterization) the organic EL device which formed the protective coat 40 like this example 4 compared with the component (example 3 of a comparison) which does not form the protective coat at all as shown in drawing 12 -- compound A, and B and D -- the thing using any and the dark spot which is the luminescence defect which the brightness reduction-by-half life of the component is prolonged in each stage, and is generated with degradation of an organic compound layer etc. hardly grow. And the component which formed the C-F compound concerning this example 4 as a protective coat 40 showed the almost same life as the component (example 4 of a comparison) driven in desiccation nitrogen. Therefore, the addition of the easy process of forming a protective coat by vacuum evaporation shows that it is possible to realize desiccation nitrogen, the component which closed the component with the closure case, and the long lasting component more than an EQC.

[0081] Moreover, it turns out that the C-F compound which that a component life is prolonged in this way requires for this invention is excellent in water repellence, and it is because the effectiveness which prevents trespass of the moisture in atmospheric air is high, and excels as a protective coat.

[0082]

[Effect of the Invention] The thermal and chemical stability of the C-F compound concerning this invention is dramatically high, and it can demonstrate functions, such as carrier transportability, such as an electron and an electron hole, or electron hole electric shielding nature.

[0083] Moreover, if the organic compound which has such C-F association is used as a functional material of devices, such as an organic EL device, a component with it will be obtained. [ good and endurance and ] [ highly efficient ] the electronic transporting bed which consists of a C-H system organic compound when the organic compound of this invention is used for an electronic transporting bed as the organic compound layer of an organic EL device, and an example -- comparing -- an electron injection property -- it is high, and since the electron mobility within a layer is large, improvement in luminous efficiency can be aimed at, lowering of driver voltage etc. is attained, and the life of a component also improves. Moreover, if it uses as an electron hole shielding layer of an organic EL device, improvement in luminous efficiency of the further component can also be aimed at.

[0084] The organic compound of this invention is useful also as a protective coat, and if it uses for device protection, while contributing to the reinforcement of a component, it is dramatically effective in respect of thin-shape-izing of a display panel etc. Moreover, since it can form by vacuum evaporation etc., this protective coat is easily producible.

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[Translation done.]